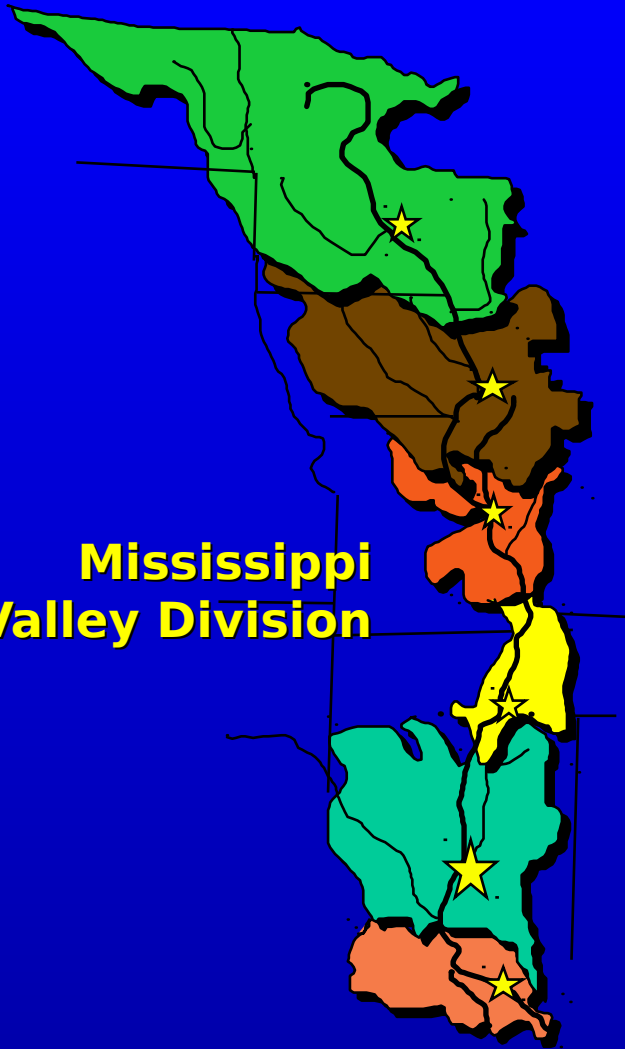




# **Tools for Adaptive Management on the Upper Mississippi River System**

**Mississippi  
Valley Division**



Ken Barr 16 July 2002

Rock Island District

# **National Significance of Upper Mississippi River System**



**“... the intent of Congress to recognize that system as a nationally significant ecosystem and a nationally significant commercial navigation system. ... shall be administered and regulated in recognition of its several purposes.”**

**Citation: Water Resources Development Act of 1986, Section 1103(a)(2).**



# ENVIRONMENTAL MANAGEMENT PROGRAM (EMP)

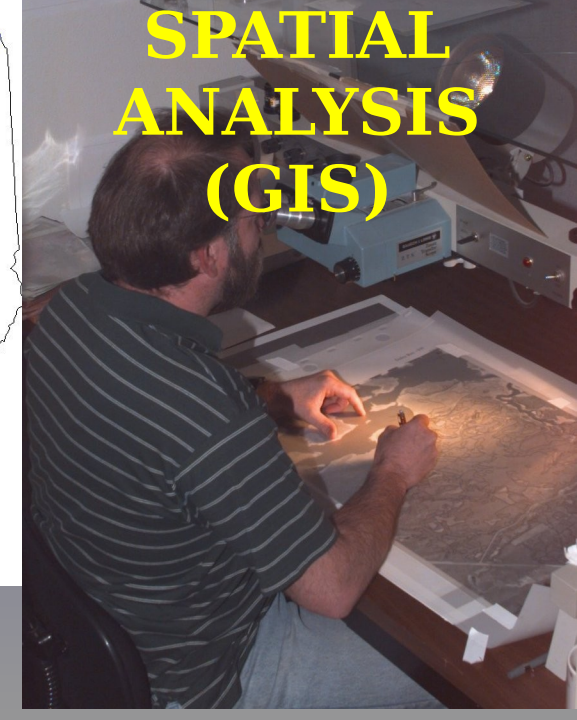
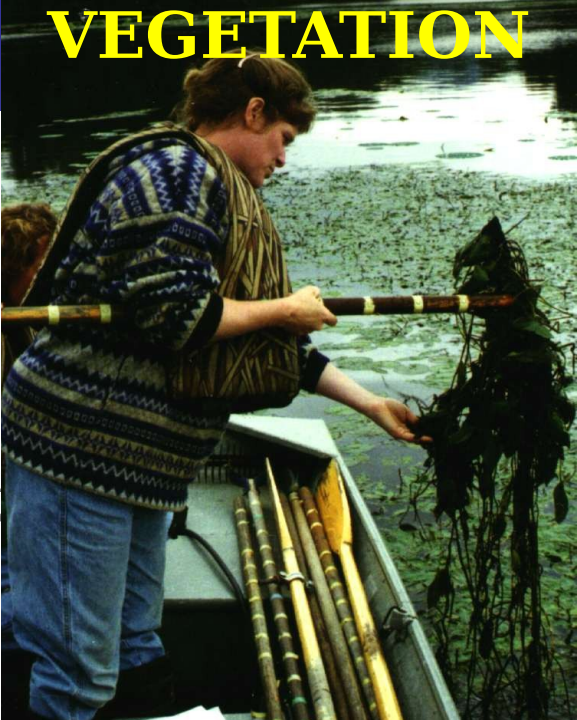


# LONG TERM RESOURCE MONITORING

- ✓ *Monitoring*
- ✓ *Data Analysis*
- ✓ *Applied Research*
- ✓ *Mapping*
- ✓ *Information  
Clearinghouse*

**PROGRAM (LTRMP)**





# HABITAT REHABILITATION AND ENHANCEMENT



## PROJECTS (HREP)

- ✓ Increase habitat diversity (wetland, aquatic, and benthic)
- ✓ Provide off-channel over wintering and spawning habitat
- ✓ Provide reliable floodplain wetlands and associated food resources
- ✓ Create additional shelter zones and nesting sites
- ✓ Increase numbers of mast

# SUMMARY 1988- 1998

*24 projects completed*

28,000 acres of habitat

*14 projects under construction*

40,000 acres of habitat

*12 projects in design*

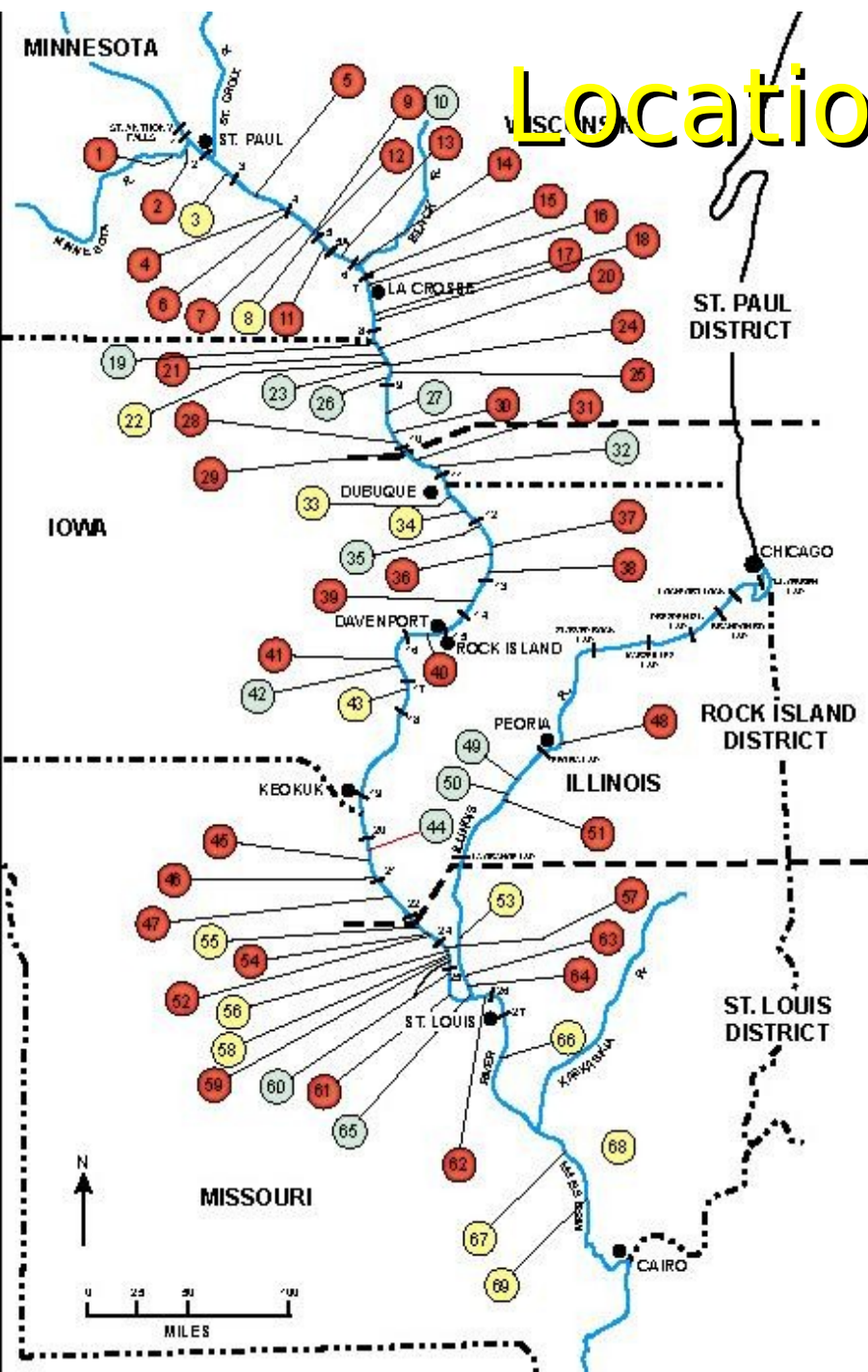
29,000 acres of habitat

50 Projects Total Acres:

97,000+

Per project range of investment: \$56,000 - \$13 million+ (majority of projects completed to date: \$1-4 million range)

# Locations of EMP Projects



## HABITAT REHABILITATION AND ENHANCEMENT PROJECTS

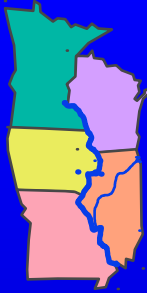
| SITE NO. | PROJECT                               | SITE NO. | PROJECT                         |
|----------|---------------------------------------|----------|---------------------------------|
| 1.       | RICE LAKE, MN                         | 35.      | PLEASANT CREEK, IA              |
| 2.       | LONGMEADOW LAKE, MN                   | 36.      | BROWN'S LAKE, IA                |
| 3.       | GOOSE LAKE, MN                        | 37.      | SPRING LAKE, IL                 |
| 4.       | PETERSO N LAKE, MN                    | 38.      | POTTERS MARSH, IL               |
| 5.       | INDIAN SLOUGH, WI                     | 39.      | PRINCETON REFUGE, IA            |
| 6.       | FINGER LAKES, MN                      | 40.      | ANDALUSIA REFUGE, IL            |
| 7.       | ISLAND 42, MN                         | 41.      | B D TIMBER, IA                  |
| 8.       | WHITEWATER RIVER, MN                  | 42.      | LAKE O BESSA, IA                |
| 9.       | SPRING LAKE PENINSULA, WI             | 43.      | HURO N ISLAND, IA               |
| 10.      | SPRING LAKE ISLANDS, WI               | 44.      | GARDNER DIVISION, IL            |
| 11.      | PO LANDER LAKE, MN                    | 45.      | COTTONWOOD ISLAND, MO           |
| 12.      | SMALLSCALE DRABOWIN, WI               | 46.      | MONKEY CHUTE, MO                |
| 13.      | TRIMPELEW REFUGE, WI                  | 47.      | BAY ISLAND, MO                  |
| 14.      | LONG LAKE, WI                         | 48.      | PEDRIA LAKE, IL                 |
| 15.      | LAKE O MALASKA, WI                    | 49.      | BANNER MARSH, IL                |
| 16.      | EAST HANDEL, IAWMN                    | 50.      | RICE LAKE, IL                   |
| 17.      | PO OLS ISLANDS, PHASE I, WI           | 51.      | CHAUTAUQUA REFUGE, IL           |
| 18.      | PO OLS ISLANDS, PHASE II, WI          | 52.      | CLARKSVILLE REFUGE, MO          |
| 19.      | PO OLS SLOUGH, IAWMN                  | 53.      | ALTON POOL, IL                  |
| 20.      | BLACK HAWK PARK, WI                   | 54.      | PHARRS ISLAND, MO               |
| 21.      | LANSING BIG LAKE, IA                  | 55.      | ANGLE BLACKBURN, MO             |
| 22.      | CONWAY LAKE, IA                       | 56.      | MORTON WOODS, MO                |
| 23.      | CAPOU SLOUGH, WI                      | 57.      | STO G & KEETO N ISLANDS, MO     |
| 24.      | PO OLS ISLAND, WI                     | 58.      | SANDY CHUTE, IL                 |
| 25.      | COLD SPRINGS, WI                      | 59.      | BATCHMAN MOUNTAIN AREA, IL      |
| 26.      | HARPERS SLOUGH, IAWMN                 | 60.      | PO OLS 25 & 26, MO              |
| 27.      | AMBROUGH SLOUGH, WI                   | 61.      | CUMFRE ISLAND, MO               |
| 28.      | BUSSEY LAKE, IA                       | 62.      | DREESER ISLAND, MO              |
| 29.      | GUTTENBERG PONDS, IA                  | 63.      | STUMP LAKE, IL                  |
| 30.      | MISS RIVER BANK STABILIZATIO N, IAWMN | 64.      | SWAN LAKE, IL                   |
| 31.      | BERTON-MO CARTNEY LAKES, WI           | 65.      | CALHOUN POINT, IL               |
| 32.      | PO OLS ISLANDS, IAWMN                 | 66.      | OSBORNE SLOUGH CHANNEL, IL      |
| 33.      | PEDSTACHANNE L, IA                    | 67.      | LEASTERN, MO                    |
| 34.      | PO OLS 12 OVERWINTERING, IA-IL        | 68.      | STO ME DIKE ALTERNATIVES, MO-IL |
|          |                                       | 69.      | SCHENMANN CHUTE, MO             |

STATUS AS OF: SEPTEMBER 1999

- UNDER CONSTRUCTION OR CONSTRUCTED
- GENERAL DESIGN INITIATED
- FUTURE OPPORTUNITIES (NOT ALL SHOWN)
- LOCK & DAM SITES

$$\begin{array}{r}
 42 \\
 13 \\
 +14 \\
 \hline
 69
 \end{array}$$

# **Environmental Management Program Habitat Rehabilitation and Enhancement Projects**



## **Performance Evaluation Process and Procedure**

Dan Holmes, P.E

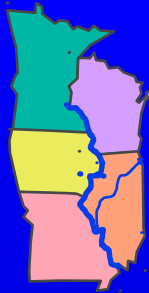
Rock Island District, U.S. Army Corps of  
Engineers

**EMP Workshop**

**St. Louis, MO**

**19-21 February 2002**

# Physical / Chemical



- **Hydrology and Hydraulics**

- Flow Velocity**

- Water Levels / Depths**

- Sedimentation Depths**

- Wave Heights**

- **Water Quality**

- Dissolved Oxygen**

- Suspended Solids**

- Temperature**

- ph**

- Column settling analyses**

- Chlorophyll**

- Total Alkalinity**

- Secchi Disk**

- **Geotechnical**

- Sediment classification**

- Water content**

- Soil strengths**

- Bulk sediment**

- **Spatial**

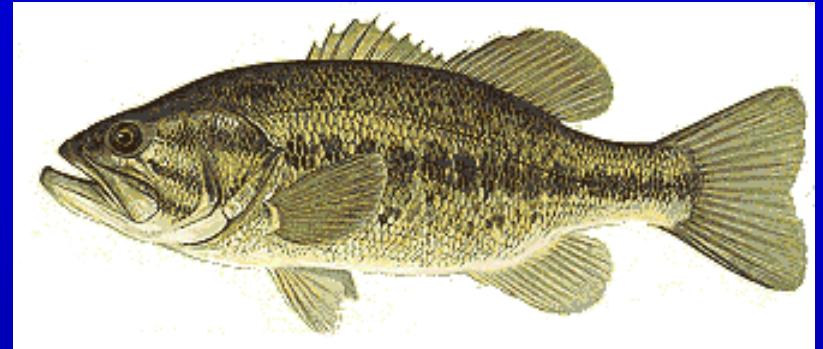
- Aerial photos / remote sensing**

# Biological Response Monitoring



Waterfowl

[http://waterfowl.virtualave.net/menuducks\\_e.html](http://waterfowl.virtualave.net/menuducks_e.html)



<http://www.state.ia.us/dnr/organiza/fwb/fish/iafish/iafish.htm#minnow>

Fish



Planted Vegetation

# Performance Evaluation Scheduling



## Full Reports (Years from Construction Completion)

1

3

5

7

10

15

20

25

35

50



Abbreviated Reports: All other y

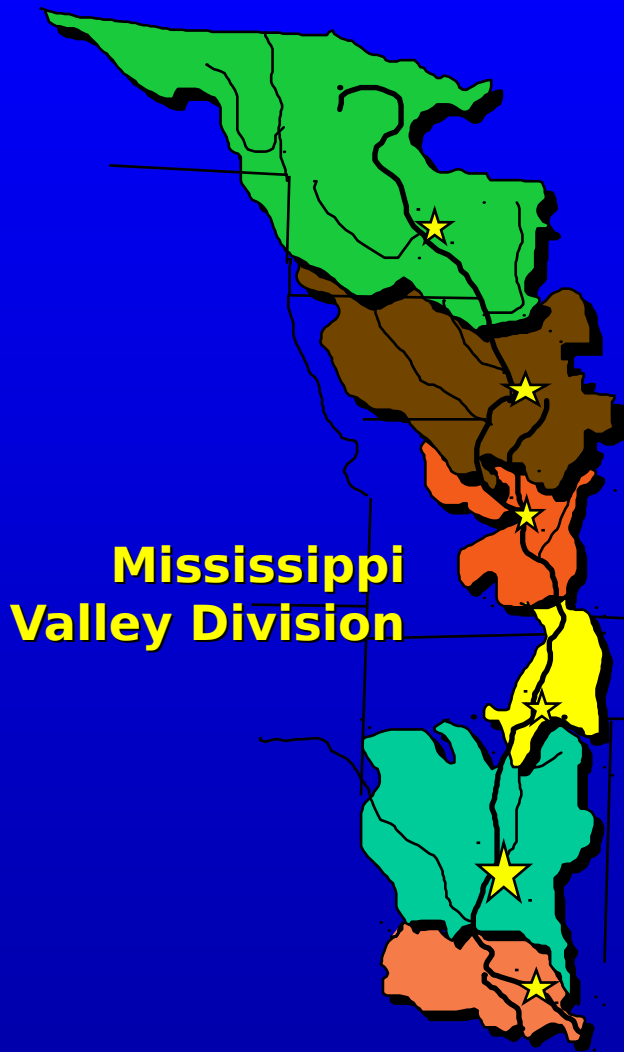


## **Project Performance Monitoring \$ as a Percentage of Total EMP \$ (based on 1997 Rpt to Congress projection thru 2002)**

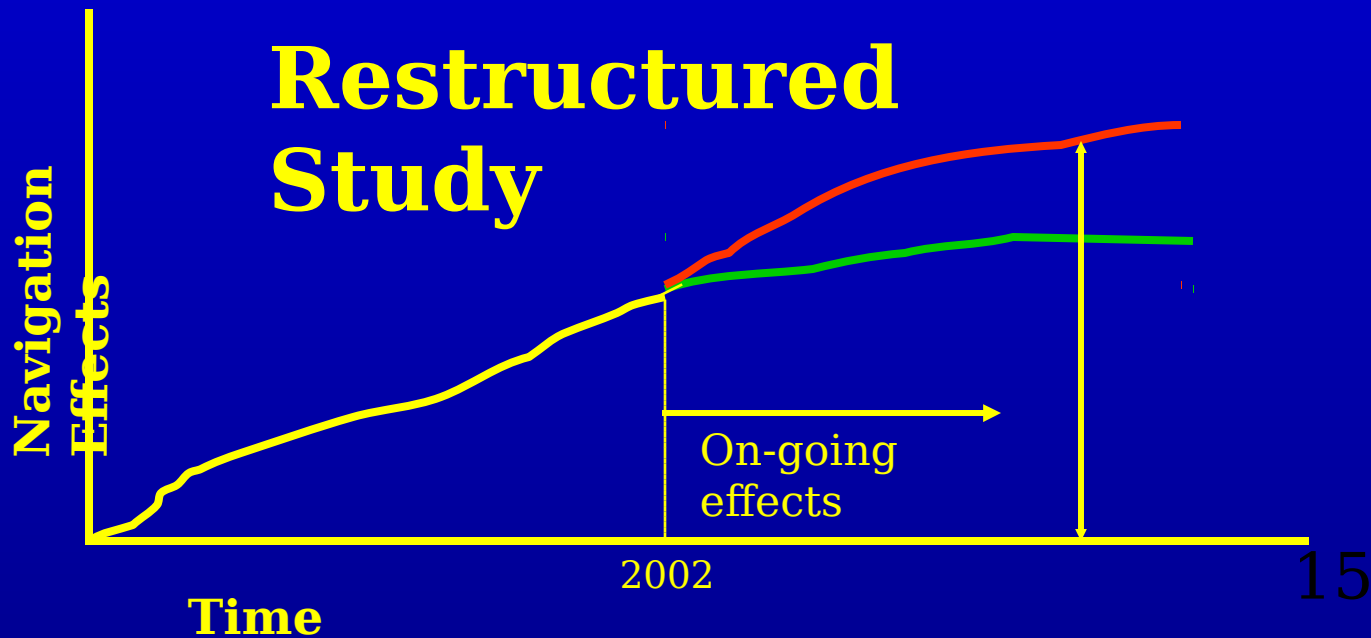
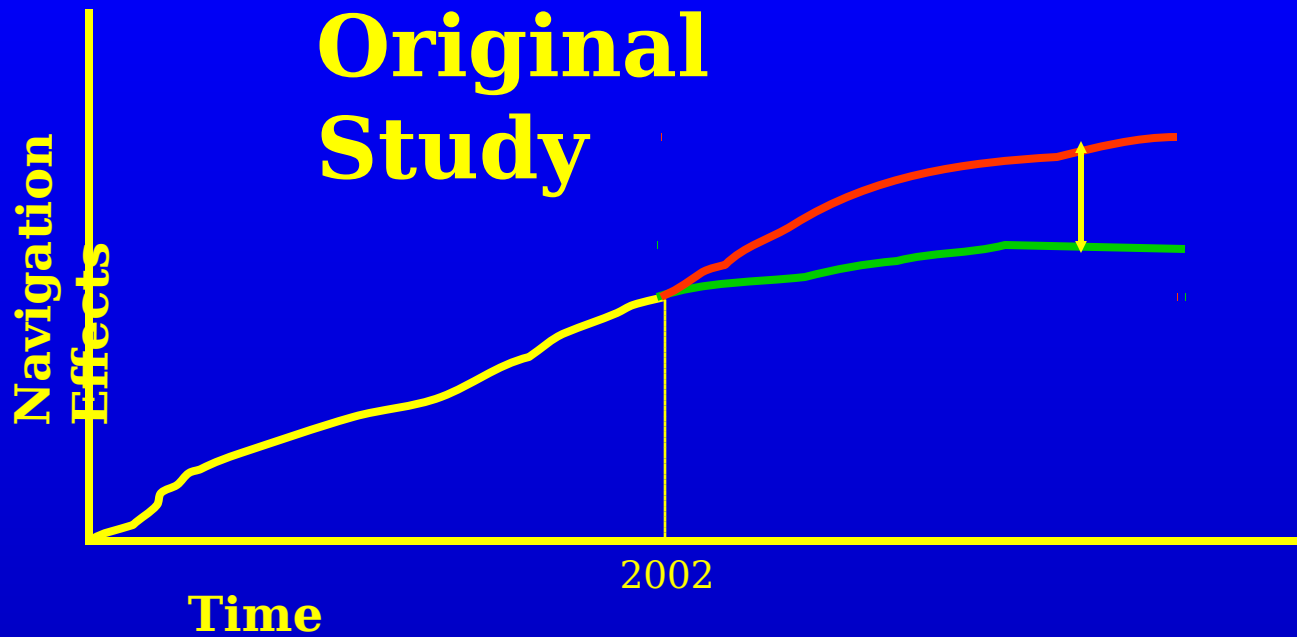
- **EMP program ~ \$238 M**
- **LTRMP ~ \$78M**
- **HREP funding ~ \$144 M (61% of total program)**
- **Performance monitoring (phys/chem/bio) ~ \$6.8 M (5% of HREP or 3% of total program)**
- **Biological monitoring\* ~ \$1.7 M (25% of Perf Mon, 1% of HREP, or <1% of total program)**

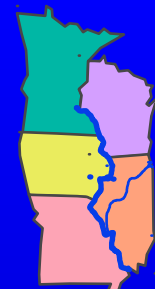
**\* [Biological monitoring conducted at ~20-25% of HREPs]**

**Parameters monitored include fisheries (field collection and creel surveys), birds (aerial and ground surveys), and vegetation (photointerpretation and ground surveys of planted vegetation)]**

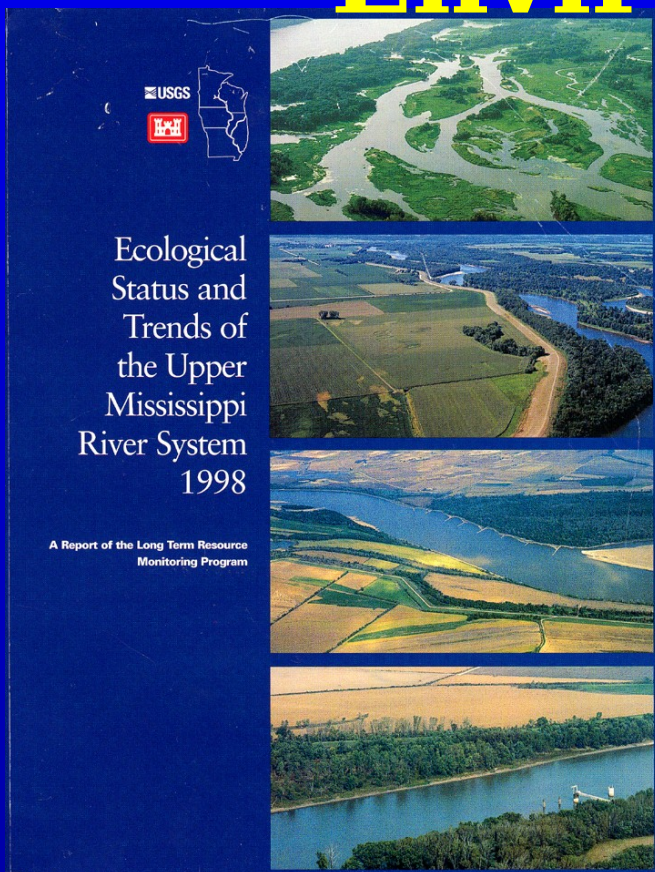


# **Upper Mississippi River - Illinois Waterway Restructured Navigation Study**

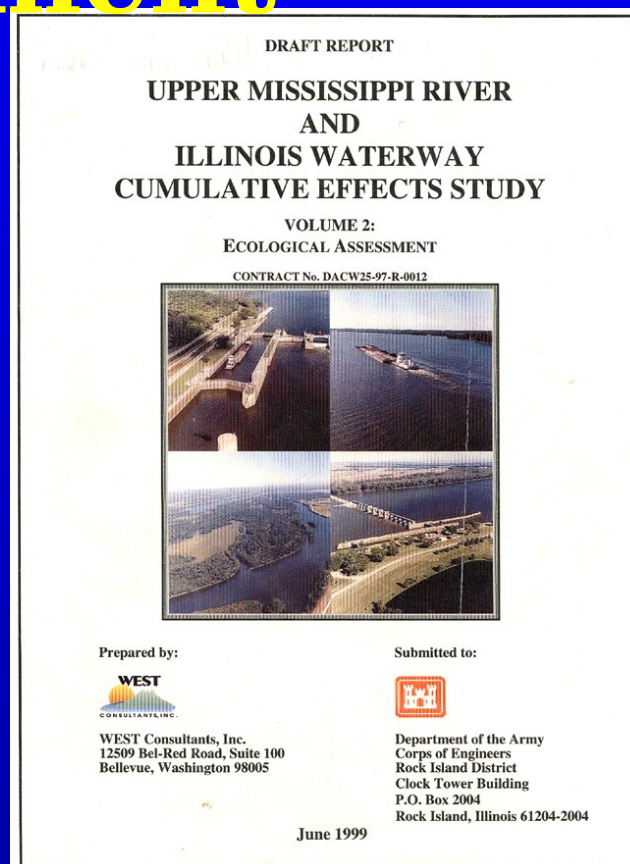




# Forecasting the Future Environment

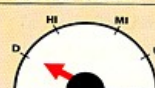
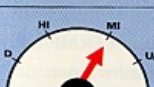
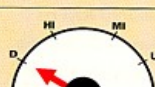
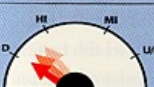
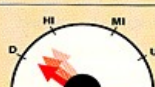
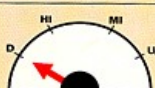
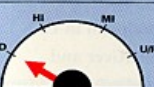
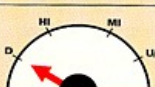


**Status and Trends  
Report**



**Cumulative Effects  
Study**

**Table 16-1. Status report on the ecological health of four floodplain reaches of the Upper Mississippi River System using a gauge grading system.**

| Criteria                                                  | Upper Mississippi River                                                                                                                                                                                   |                                                                                                                                                                                                         |                                                                                                                                                                                                                 | Illinois River                                                                                                                                                                                        |
|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                           | Upper Impounded Reach (Pools 1-13)                                                                                                                                                                        | Lower Impounded Reach (Pools 14-26)                                                                                                                                                                     | Unimpounded Reach                                                                                                                                                                                               | Illinois River Lower Reach                                                                                                                                                                            |
| <b>1. Viable native populations and their habitats</b>    |  <p>Moderately Impacted/declining</p> <p>Declining structural diversity; zebra mussels threatening native mussels</p>    |  <p>Moderately Impacted/declining</p> <p>Floodplain habitat moderately altered by levees; forest diversity limited</p> |  <p>Heavily Impacted/stable</p> <p>Floodplain habitat greatly altered by levees; side channels closed</p>                    |  <p>Degraded/stable</p> <p>Aquatic vegetation, invertebrates, water-fowl degraded</p>                              |
| <b>2. Ability to recover from disturbances</b>            |  <p>Moderately Impacted/stable</p> <p>Recovery demonstrated by invertebrates and aquatic vegetation</p>                  |  <p>Heavily Impacted/stable</p> <p>Limited regeneration of willows and cottonwoods</p>                                 |  <p>Moderately Impacted/stable</p> <p>Willows and cottonwoods regenerating</p>                                               |  <p>Degraded/stable</p> <p>Neither aquatic plants nor invertebrates have recovered from 1950s disturbances</p>     |
| <b>3. Ecosystem sustainability</b>                        |  <p>Moderately Impacted/declining</p> <p>Habitat quality declining as pools slowly age</p>                               |  <p>Degraded/declining</p> <p>Greater sediment loads increase pool aging rates</p>                                     |  <p>Degraded/declining</p> <p>Incidence of greater floods and lower low-flows increasing</p>                                 |  <p>Degraded/declining</p> <p>Reduced point-source pollution offset by high sediment loads</p>                     |
| <b>4. Capacity to function as part of a healthy basin</b> |  <p>Moderately Impacted/stable</p> <p>Least amount of basin land-cover change</p>                                        |  <p>Heavily Impacted/stable</p> <p>Land-cover change has altered water and materials delivery</p>                      |  <p>Heavily Impacted/declining</p> <p>Land-cover change and Missouri River dams have altered water and sediment delivery</p> |  <p>Degraded/stable</p> <p>Land-cover change has altered water and material delivery</p>                           |
| <b>5. Annual floodplain connectivity</b>                  |  <p>Moderately Impacted/stable</p> <p>Low-flow, floodplain drying eliminated by impoundment; 3% of floodplain leveed</p> |  <p>Heavily Impacted/stable</p> <p>Low-flow, floodplain drying eliminated by impoundment; 53% of floodplain leveed</p> |  <p>Degraded/stable</p> <p>Flood-pulse value reduced by rapid water-level changes; 82% of floodplain leveed</p>              |  <p>Degraded/stable</p> <p>Low-flow floodplain drying eliminated by impoundment; 50% of floodplain leveed</p>      |
| <b>6. Ecological value of natural disturbances</b>        |  <p>Degraded/stable</p> <p>Ecological value of floods reduced by channel stabilization; low stages eliminated</p>       |  <p>Degraded/stable</p> <p>Ecological value of floods reduced by channel stabilization; low stages eliminated</p>     |  <p>Degraded/stable</p> <p>Ecological value of floods reduced by channel stabilization</p>                                  |  <p>Degraded/stable</p> <p>Ecological value of floods reduced by channel stabilization; low stages eliminated</p> |

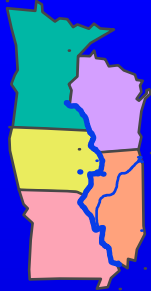
**Change indicator**



**Present status**

D = Degraded  
 HI = Heavily Impacted  
 MI = Moderately Impacted  
 U/R = Unchanged/Recovered

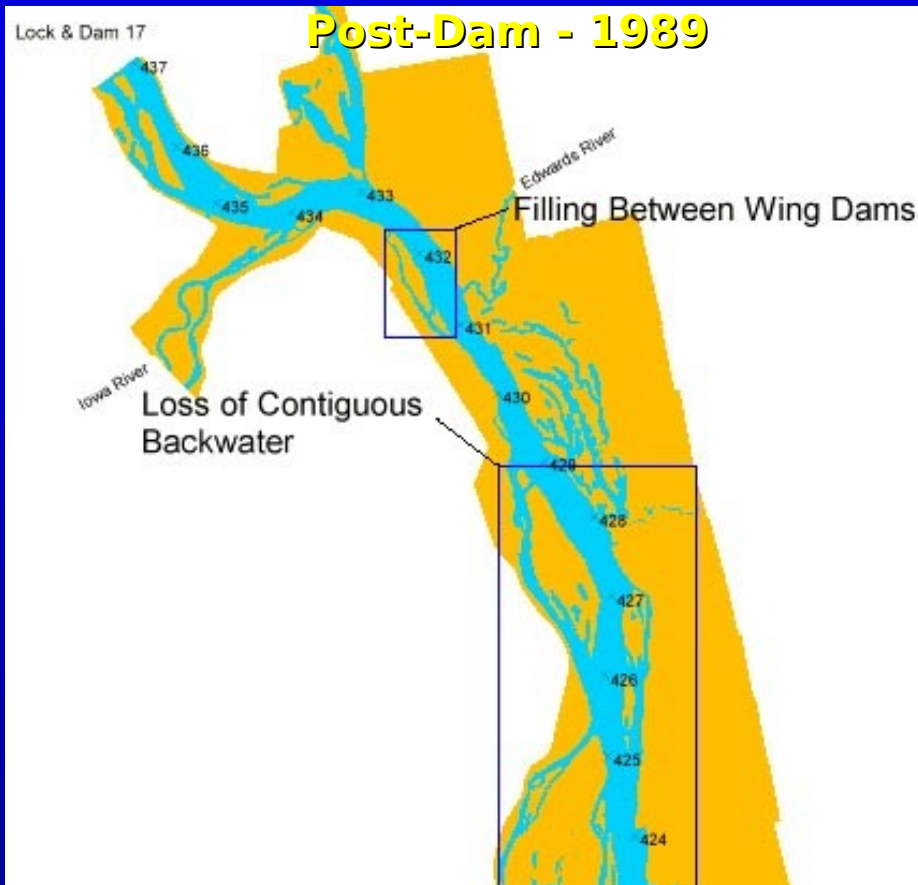
# Cumulative Impacts



## Historical Changes

### Mississippi River - Pool 18

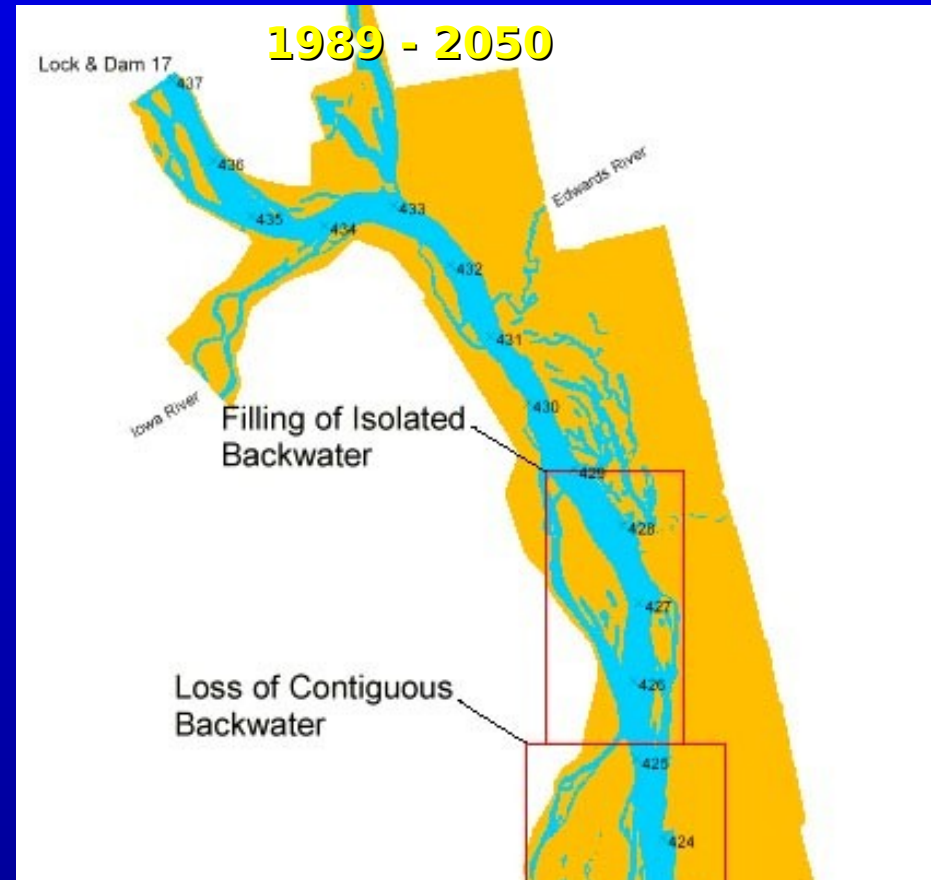
#### Post-Dam - 1989



## Projected Changes

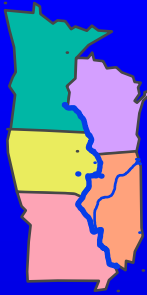
### Mississippi River - Pool 18

#### 1989 - 2050



# Goals and Objectives

---



## Overall Goal

- Sustainable River System

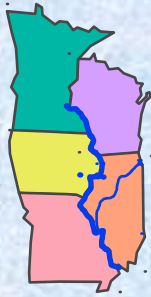
## Ecosystem Goals

- Maintain native ecosystem types
- Maintain viable populations of native species
- Restore and maintain ecological processes
- Integrate human use within these constraints

## Measurable Objectives

- Spatially explicit
- Quantitative

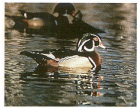
# Consideration of Other System Planning Efforts



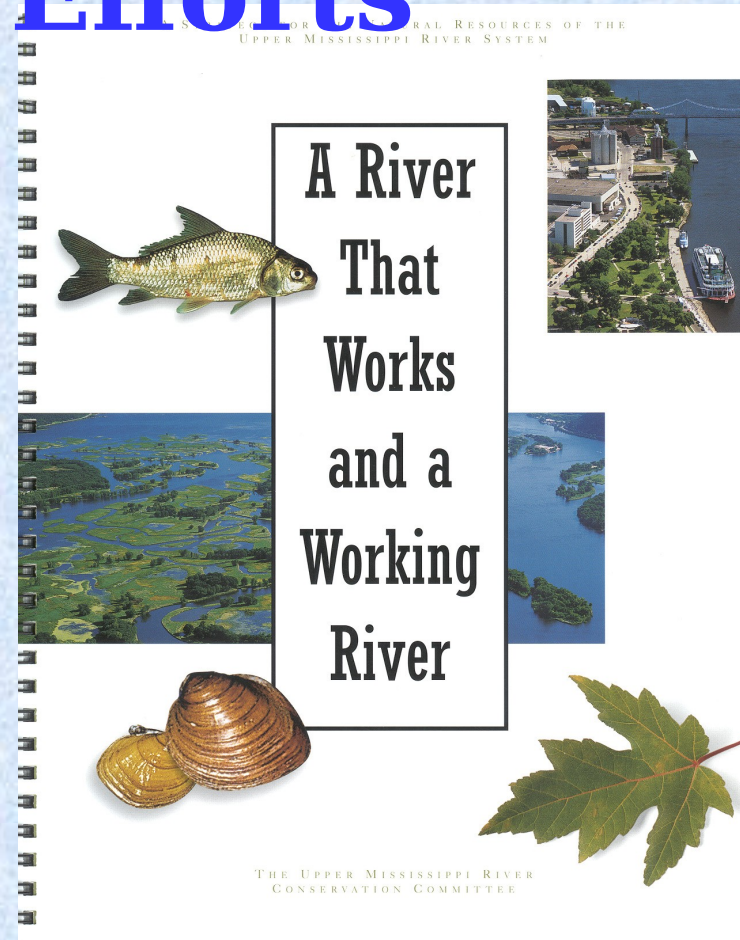
## Upper Mississippi River System

### Habitat Needs Assessment

Summary  
Report  
2000



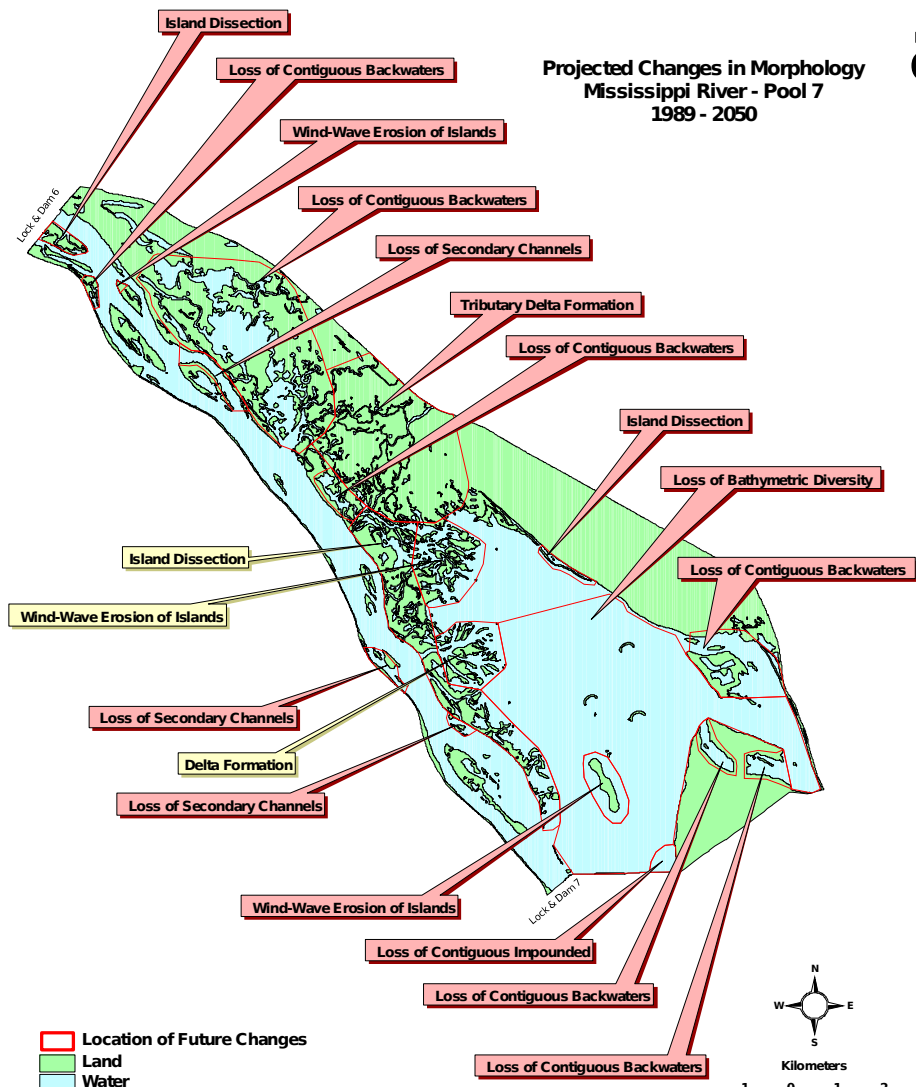
U.S. Army  
Corps of Engineers®



# Qualitative Geomorphic Change Analysis and Future Prediction



Projected Changes in Morphology  
Mississippi River - Pool 7  
1989 - 2050



Yellow labels denote changes identified in the Cumulative Effects Study. Light red labels denote changes identified at the HNA resource manager workshops.

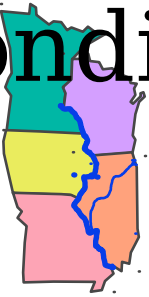
## and Future Prediction

## Natural Resource Management

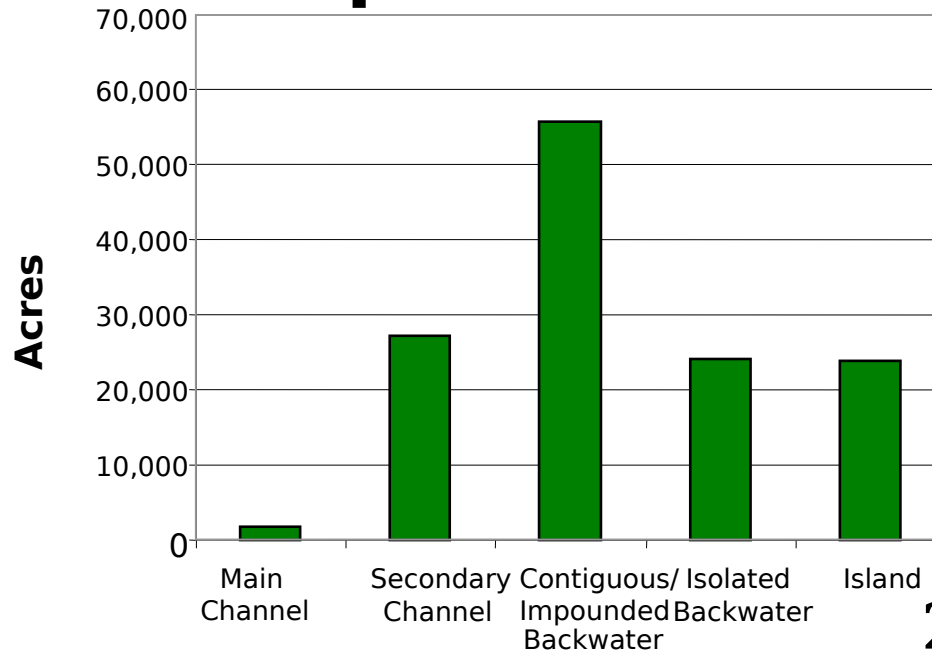
| Geomorphic Process            | Number of Occurrences |
|-------------------------------|-----------------------|
| Channel Formation             | 3                     |
| Delta Formation               | 3                     |
| Filling between Wing Dams     | 34                    |
| Island Dissection             | 15                    |
| Island Formation              | 20                    |
| Island Migration              | 4                     |
| Loss of Contiguous Impounded  | 9                     |
| Loss of Bathymetric Diversity | 12                    |
| Loss of Contiguous Backwaters | 153                   |
| Loss of Isolated Backwaters   | 49                    |
| Loss of Cont/Iso Backwaters   | 32                    |
| Loss of Secondary Channels    | 116                   |
| Loss of Tertiary Channels     | 5                     |
| Shoreline Erosion             | 8                     |
| Tributary Delta Formation     | 43                    |
| Wind-Wave Erosion of Islands  | 25                    |
| <b>Total</b>                  | <b>531</b>            |

# Resource Manager's Desired Future Conditions

- Improved Habitat Quality
- Increased Habitat Diversity
- Naturalized Hydrologic Regime



## UMRS Aquatic Habitat Need



# **Previous UMRS Planning Goals and Objectives or Evaluation Criteria**

---



## **HNA (Quantitative):**

### **System-wide Habitat Needs**

#### **Create or restore:**

**1,700 acres of main channel habitat**

**27,000 acres of secondary channel  
habitat**

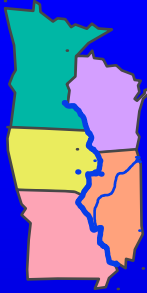
**55,500 acres of contiguous backwater**

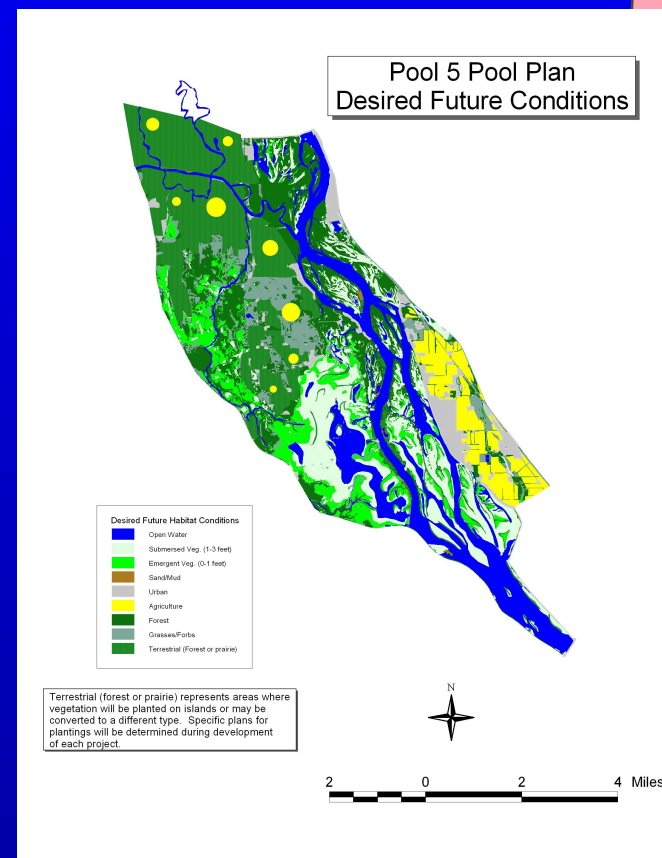
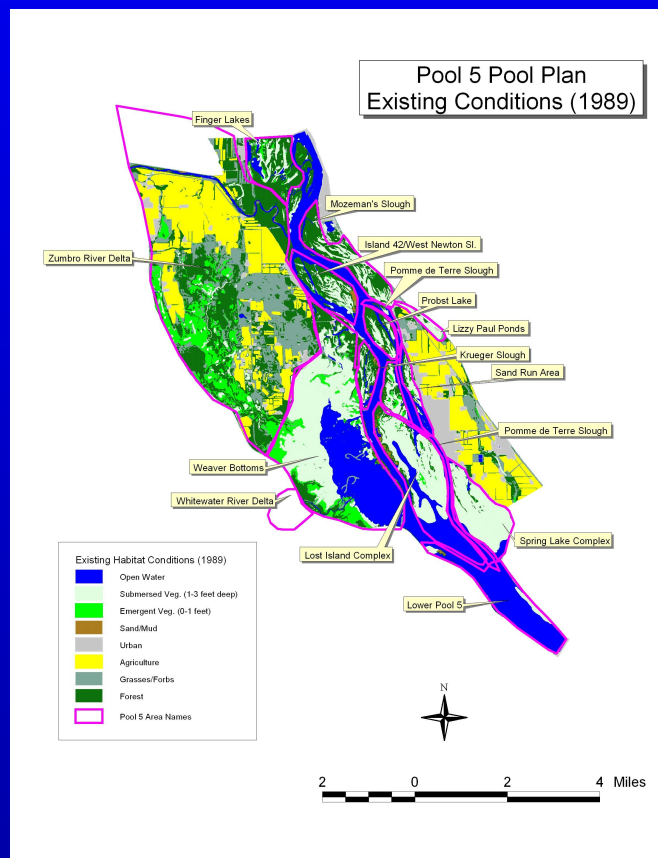
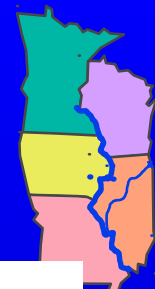
**24,000 acres of isolated backwater  
habitat**

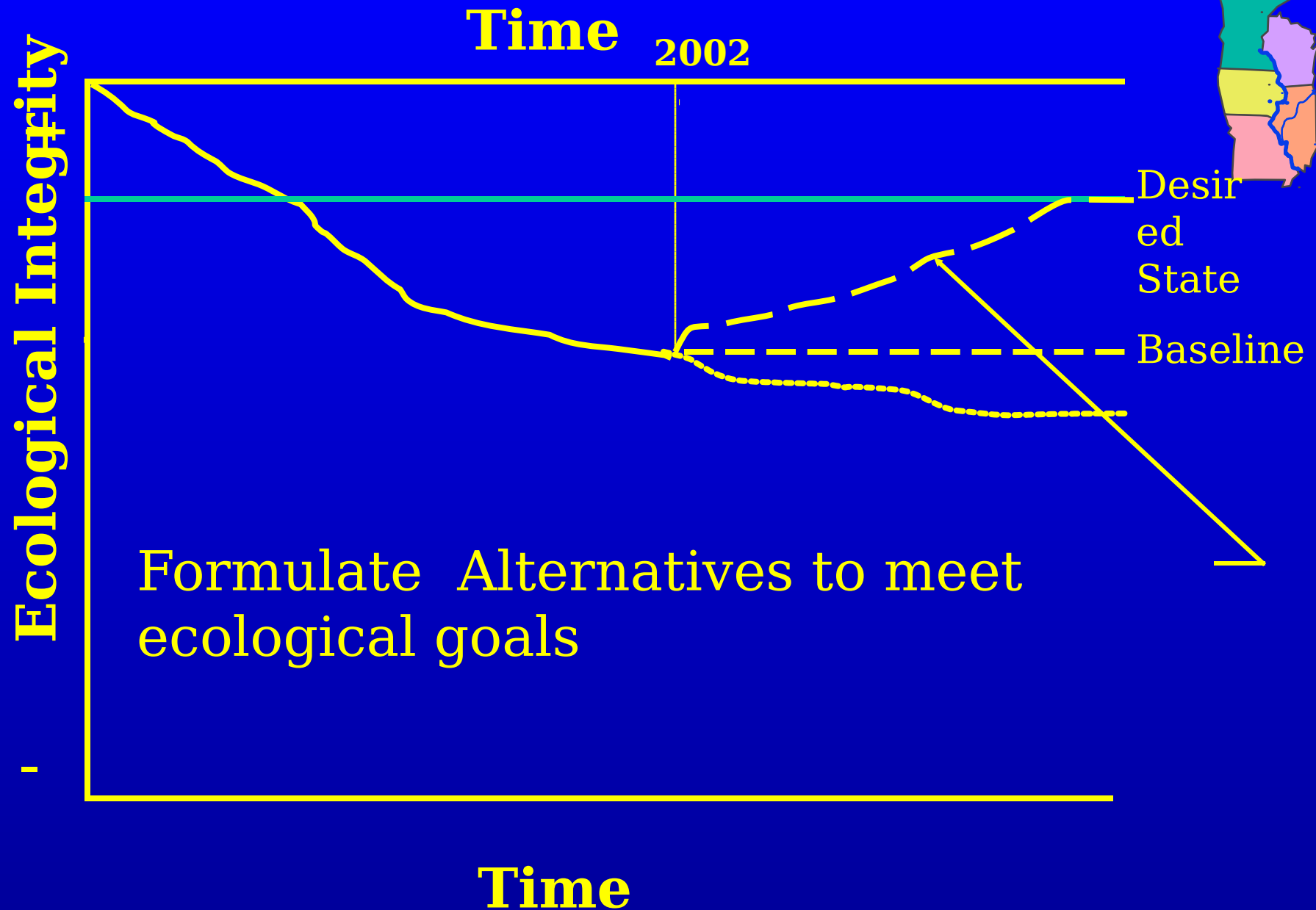
**24,000 acres of island habitat**

## Components of A Strategy for Operation and Maintenance of the UMRS Ecosystem

| Objectives                                                                                                                     | Tools or Measures                                                                                                             | Goals and Benefits                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <b>1</b> Improve water quality for all uses.                                                                                   | More effective use of federal/state/local tools.                                                                              | Meet Clean Water Act goals by 2010                                                                                  |
| <b>2</b> Reduction in erosion and sediment impacts.                                                                            | More effective use of federal/state/local tools.                                                                              | Target programs for improved results by 2010                                                                        |
| <b>3</b> Return of natural floodplain to allow channel meanders and habitat diversity.                                         | Implement 3-step effort: moratorium, no-net-loss, and acquisition from willing sellers.                                       | Increase of 60,000 acres of floodplain forest and wetlands by 2010 and reduced flood damages                        |
| <b>4</b> Provide for seasonal flood pulse effect and periodic low flows to improve nutrient base, plant growth and succession. | Design/implement operations at selected dams to mimic natural events and restore floodplain area & connectivity (open river). | Complete five new successful projects resulting in increased biological diversity and improved river health by 2010 |
| <b>5</b> Enable connectivity of backwaters to main channel.                                                                    | Incorporate into above measures and augment by site specific projects.                                                        | Restore 100,000 acres of aquatic habitat and add recreational benefits by 2010                                      |
| <b>6</b> Provide for opening of side channels, create islands, shoal and sandbar habitat.                                      | Use pool modeling and/or backwater dredging, water level controls, islands and channel modifications.                         | Restore 100,000 acres of sandbar, floodplain forest and island habitat and add recreational benefits by 2010        |
| <b>7</b> Manage channel maintenance and disposal to support ecosystem objectives.                                              | Seek ways to reduce dredging needs and manage to support ecosystem integrity.                                                 | Improve main channel fishery, reduce dredging needs, & test ways to manage for multiple uses                        |
| <b>8</b> Sever the pathway for exotics into and spread within the UMRS.                                                        | Use physical barriers or other means. (New area of research and development.)                                                 | Economic and environmental benefits based on zebra mussel damages evaluation                                        |
| <b>9</b> Provide native fish passages at dams.                                                                                 | Modify dam structure or operations.                                                                                           | Improve populations of specified fish species                                                                       |







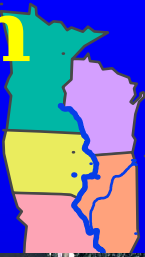
# Water Level Management to Improve Aquatic Habitat

Peck Lake, Pool 9, Wisconsin

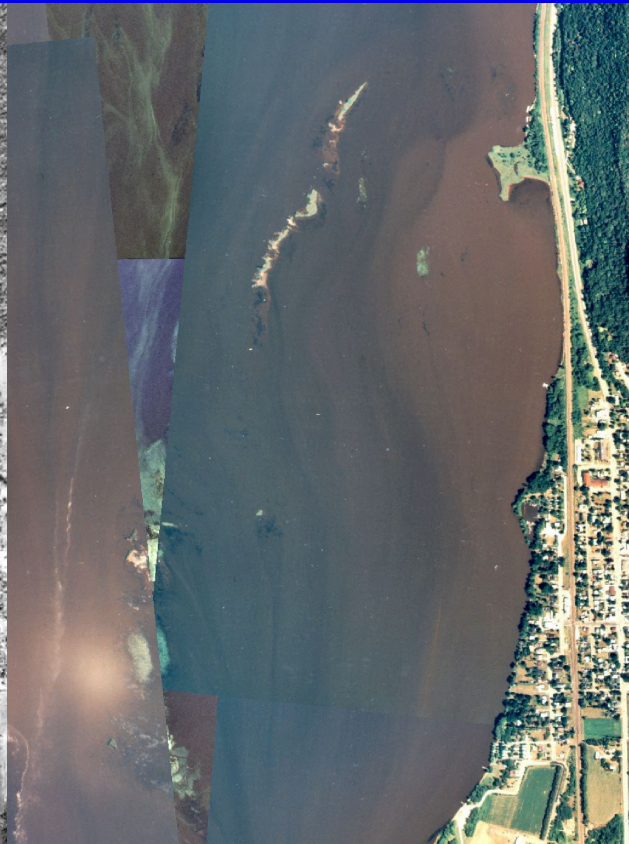


# Island Protection and Restoration

Pool 8 Islands HREP Phase II,  
near Stoddard, Wisconsin



October 1961



August 1994

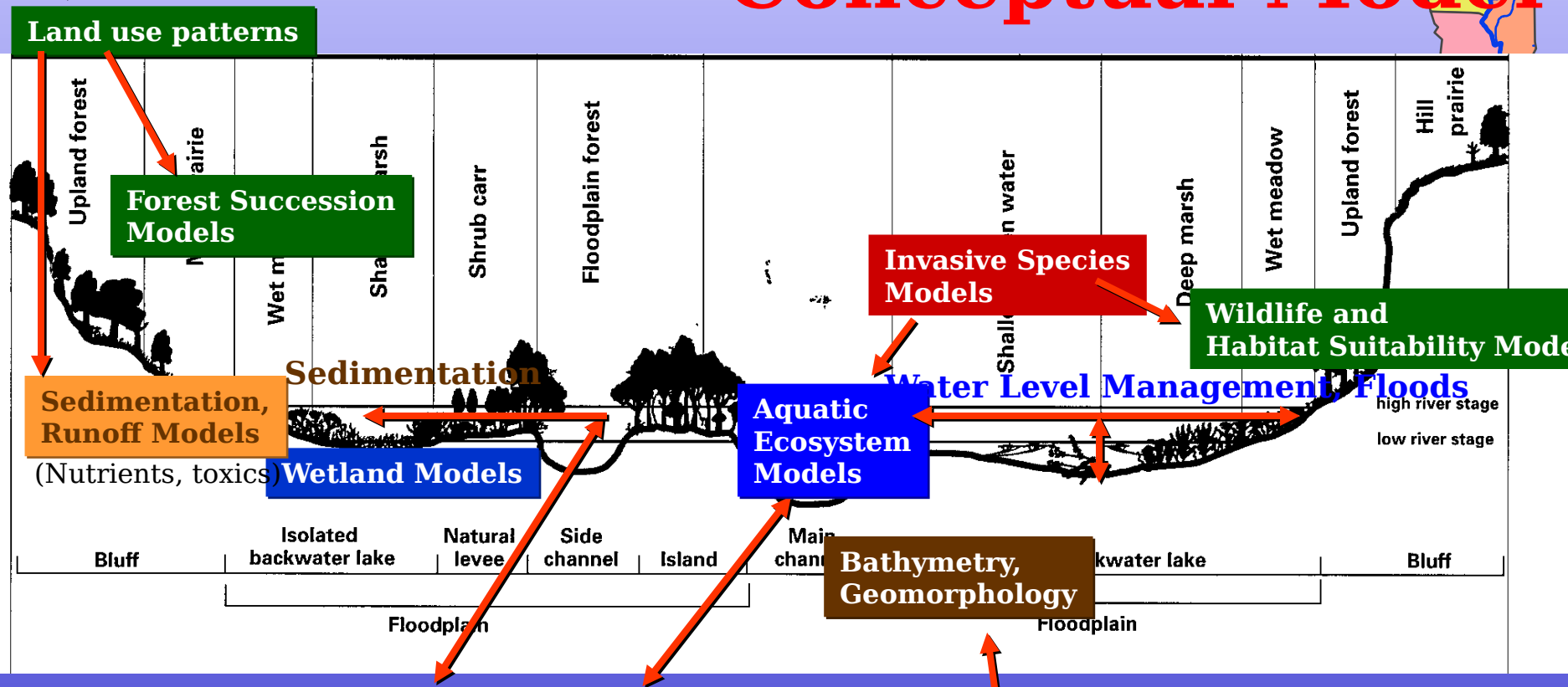


August 2000

## Economic Model Outputs

## Socio-political Model Outputs

# UMRS Environment Conceptual Model



## Environmental Management Plans



Rock Island District

Discharge Regime, Hydraulics,  
Water Level Management

Impoundment,  
9-foot channel project  
Navigation  
O&M

**INFORMATION**

**ASSESSMENT**

**PLANNING**

**ADAPTIVE  
MANAGEMENT**

**MONITORING**

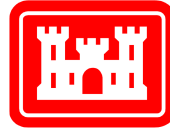
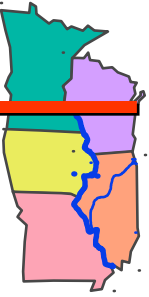
**IMPLEMENTATION**



Rock Island District

[www.mvr.usace.army.mil/EMP/default.htm](http://www.mvr.usace.army.mil/EMP/default.htm)  
<http://www2.mvr.usace.army.mil/umr->

# COLLABORATION



US Army Corps  
of Engineers®



Corporations

Levee Districts



PUBLIC

NGO's

